canusa Newsletter

Canada
United States
Spruce Budworms
Program

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Spruce Budworm Conditions in the United States, 1982

As part of its charge, State and Private Forestry, USDA Forest Service prepares a summary of forest insect and disease conditions nationwide. Dan Kucera and Pete Orr, of the Northeastern Area of State and Private Forestry in Broomall, Pennsylvania, prepared the following material on spruce budworm and western spruce budworm conditions in 1982. Duane L. Green, Deputy Director of Planning and Protection at Broomall, presented this report to the Eastern Spruce Budworm Council in Quebec City on November 9, 1982. The *Newsletter* gratefully acknowledges State and Private Forestry's permission to reprint.

Spruce Budworm

Lake States

Defoliation of balsam fir and white spruce occurred on 98 820 ha (244,000 acres) on State, private, and Federal lands, a slight decrease over 1981. All defoliation was of light to moderate intensity except in Minnesota, where 19 596 ha (48,421 acres) were heavily defoliated.

A survey is now underway to determine the volume of timber killed in Minnesota and on the National Forests in Wisconsin and Michigan as a result of the budworm outbreak that occurred between 1974 and 1981. Preliminary results in Minnesota show that tree mortality occurred on 75 224 ha (185,876 acres). This mortality amounted to more than 50 percent on 17 121 ha (42,305 acres), or 23 percent of the area.

Budworm population trends are expected to be upward in Minnesota, downward in Michigan, and remain at low levels in Wisconsin during 1983.

Maine

In 1982, defoliation in the light category was 1.62 million ha (4 million acres) and in the moderate to severe category, 1.34 million ha (3.3 million acres). Defoliation was more severe in some areas than in 1981, especially in Washington County and in northwestern Maine. Budworm levels appear on the increase, in general.

Tree mortality in 1982 encompassed about 97 200 ha (240,000 acres) of greater-than-50-percent fir mortality, while spruce is just now beginning to die. Another 121 500 ha (300,000 acres) has 10- to 25-percent fir mortality occurring in patches of 40 ha (100 acres) or less. Hemlock mortality occurred at about the same degree as fir mortality. Until now, defoliation of spruce has not caused significant tree mortality, but it is rising rapidly.

The 1982 Maine Forest Service aerial spray program against the spruce budworm began on May 21 and ended on June 15. The project covered 333 230 ha (822,790 acres). As in the past, most of the acreage (277 993 ha — 686,402 acres) was sprayed with carbaryl in split or single applications. The remaining project area was sprayed with acephate (18 987 ha — 46,882 acres) or with one of three B.t. products (36 250 ha — 89,506 acres). Dipel, Thuricide, and Bactospiene were the B.t. products used. Private owners sprayed aminocarb over 12 150 ha (30,000 acres). Control was reported as excellent with all insecticides.

Many of the blocks treated in 1982 had been protected annually for several years and were in fair or good condition. Some areas, mostly in the southern half of the infested area, had not been protected recently and were in critical condition. In the southeast, blocks contained large volumes of dead fir but were treated to protect surviving spruce. Hemlock was also in poor condition in this area.

The 1982 project was extremely complicated operationally, involving 7 insecticides, 11 application rates, and many timing variations. Much of the carbaryl was applied in split applications timed to protect spruce. All B.t. materials were applied at one application of 12 billion international units per acre (30 BIU/ha), but volume per acre and aircraft varied. Acephate was applied at one rate, but with variable timing.

The cooperative growth impact project with industry, the University of Maine, Maine Forest Service, and the USDA Forest Service is now in its eighth year. The 1982 data show a sharp increase in the loss of fir. Up until 1982, the loss of spruce was minimal. However, loss in this budworm-resistant tree species is beginning to rise. Red spruce seems to be dying quicker than either white or black spruce.

For 1983 the area of heavy infestation is expected to increase to about 2.23 million ha (5.5 million acres). Populations are building in lightly defoliated areas and those with heavy defoliation are showing a marked increase in intensity.

The State of Maine proposes to treat approximately 405 000 ha (1 million acres) in 1983. Insecticides of choice are acephate, aminocarb, carbaryl, fenithrothion, zectran, and the biological B.t.

New Hampshire

An estimated 3 000 to 4 000 ha (8,000 to 10,000 acres) were lightly defoliated in 1982. Tree mortality continues on about 25 percent of this area. Salvage efforts also continue. Both dead and dying trees are being removed, and also those under severe stress.

For 1983, defoliation intensity is expected to be low, but the infestation will probably expand to about 8 100 ha (20,000 acres), double that of 1982. The State of New Hampshire proposes to treat 810 ha (2,000 acres) in 1983.

Vermont

In 1982, defoliation increased to 60 750 ha (150,000 acres), which is an increase of over 20 235 ha (50,000 acres) from 1981. Defoliation has been on a steady rise over the last 7 years. Tree mortality is occurring on over 34 425 ha (85,000 acres) with 6 075 ha (15,000 acres) in the over-25-percent category. The dollar value attributed to timber killed by the budworm exceeds $2 million per year, not counting other values. Salvage of dead and dying trees including harvest for fuelwood, is being conducted wherever possible.

For 1983, Vermont proposes to treat approximately 6 075 ha (15,000 acres). In addition, a demonstration project involving silviculture, targeted harvesting, timber management, deer habitat management, and suppression is planned on about 4 050 ha (10,000 acres) for 1983. Public support for this long-term (10-year) effort in northern Vermont appears to be strong.

Western Spruce Budworm

Region 1 — Northern

Western spruce budworm defoliation in the Northern Region for 1982 was 910 798 ha (2,248,884 acres). This is a substantial increase (by 2-1/2 times) over 1981, when only 377 512 ha (932,128 acres) of defoliation were detected.

Following evaluations of 1981, B.t.-treated blocks show that both western spruce budworm populations and defoliation levels continue to be lower than in untreated areas.

The Beaverhead National Forest has expressed interest in a control project for 1983. The Region is still evaluating egg-mass data, so it is not possible to make projections for 1983 at this time.

Region 2 — Rocky Mountain

Defoliation in Colorado in 1982 was over 729 000 ha (1.8 million acres) and in Wyoming, over 81 000 ha (200,000 acres). Although there were no suppression projects conducted by the Forest Service, several private landowners did treat their lands in 1982.

The outbreak appears to be on the decline in Colorado, while in Wyoming it is increasing in intensity, especially on the Shoshone National Forest.

An environmental analysis was conducted in the spring of 1982. Recommendations resulting from this analysis are to let the outbreak run its course in unmanaged stands (target mortality), and to treat high-value trees on private lands (ground applications only).

Region 3 — Southwestern

The western spruce budworm defoliated over 138 058 ha (340,885 acres) in 1982, which is a marked decline over 1981. A cooperative suppression project with New Mexico using carbaryl and B.t. was conducted on 27 681 ha (68,347 acres). Of this, approximately 1 620 ha (4,000 acres) was treated with B.t. and the rest with carbaryl.

In 1983, defoliation is expected to remain static or decrease slightly.

Region 4 — Intermountain

Defoliation in the Intermountain Region increased in extent and intensity over 1981. Much of the defoliation occurred in Idaho and represents an increase of over 400 000 ha (1 million acres) this past year. Total defoliation is as follows:

Idaho	914 738 ha	(2,258,612 acres)
Wyoming	82 539 ha	(203,800 acres)
Utah	18 590 ha	(45,900 acres)
	1 015 867 ha	(2,508,312 acres)

Although no suppression was conducted in 1982, the region did conduct silvicultural cuttings to reduce susceptible timber type. Additional silvicultural cuts are planned on the Payette National Forest in 1983.

Defoliation is expected to increase in 1983. Suppression is being considered, but this may be affected by the pending court suit filed against the Forest Service by Boise Cascade. The Forest Service is being sued for not spraying to combat the current outbreak.

Region 5 — Pacific Southwest

Approximately 2 200 ha (5,436 acres) of western spruce budworm defoliation was reported in 1982. This was only the second known report of defoliation by this insect in the Pacific Southwest Region and the first that involved an area of this magnitude. Ground surveys showed the western budworm to be at detectable levels on over 13 500 ha (33,359 acres), but only 2 200 ha (5,436 acres) showed defoliation visible from aerial surveys. The level of infestation is expected to increase in 1983. Douglas-fir is the species most affected.

Region 6 — Pacific Northwest

The area of defoliation in Oregon increased markedly, from 2 430 ha (6,000 acres) in 1980 to 120 091 ha (296,520 acres) in 1981. In 1982 it again increased much faster than anticipated, to over 606 000 ha (1,497,426 acres). The area of defoliation is primarily on National Forest lands.

In a cooperative project involving State, private, Bureau of Land Management, and USDA Forest Service lands, 72 250 ha (178,530 acres) were treated in 1982. Of this 3 642 ha (9,000 acres) were treated with acephate and the rest with carbaryl.

In the State of Washington, the area of infestation decreased from 12 000 ha (29,652 acres) in 1981 to 2 902 ha (7,166 acres) in 1982.

For 1983, the Pacific Northwest Region plans on conducting special projects involving the use of zectran and B.t.

Table 1. Summary of 1982 spruce budworm defoliation, tree mortality suppression and forecast of 1983 infestation

State/ Region	Visible Defoliation		Tree Mortality		Sprayed		Defoliation Forecast for 1983	
	thousands of acres/hectares							
	Eastern United States							
MI	116	47	803	325	1[a]	0.4[a]	49(−)	20(−)
MN	126	51	185	75	—	—	178(+)	72(+)
WI	2	1	49	20	—	—	—(−)	—(−)
ME	7,300	2956	540	219	823	333	5,500(+)[b]	2228(+)[b]
NH	10	4	—	—	—	—	20(+)	8(+)
VT	150	61	85	34	—	—	150(+)	61(+)
Totals	7,704	3120	1,662	673	823	333	5,799	2389
	Western United States							
R-1	2,247	910	Yes		—	—	—(+)	—(+)
R-2	2,002	811	Yes		—	—	—(−)	—(−)
R-3	341	138	Yes		68	27	—(−)	—(−)
R-4	2,508	1016	Yes		—	—	—(+)	—(−)
R-5	5	2	No		No		—(+)	—(+)
R-6	1,505	609	Yes		178	72	1,796(+)	727(+)
R-10	—	—	No		—	—	—(−)	—(−)
Totals	8,608	3486			246	99	1,796	727

[a] CANUSA special project
[b] Reflects heavy defoliation only

Region 10 — Alaska

The 1981 budworm population levels — 2 710 ha (6,696 acres) — were not detectable in Alaska in 1982. In followup ground surveys in 1982, little visible budworm damage was detected on white spruce.

Life history and pheromone studies are continuing in cooperation with the Canadian Forestry Service. Results of these studies support the opinion that the Alaskan budworm closely resembles *C. orae* Free. Efforts to delineate this species and its impacts are continuing.

CANUSA—East

In 1982, CANUSA-East sponsored a series of B.t. field tests in Maine, Michigan, Vermont, and also Canada. Preliminary results indicated that the 1/2 gallon rate (1.23 gal/ha) is equally as effective as 1 gallon or more per acre (2.47 gal/ha). In one test in 1982, undiluted B.t., or "Neat" as it is called, at 1 quart/acre (0.6 gal/ha) was equally as effective as the 1/2- and 1-gallon-per-acre rates. In addition to CANUSA results, operational work in 1982 indicated that 30 BIU/ha (12 BIU/acre) is preferred over 20 BIU/ha (8 BIU/acre). The higher rate is now considered the recommended rate.

This study concluded CANUSA-East work involving B.t. field tests. No further work is planned with B.t. in 1983 or beyond this time.

Abstracts from Toronto

The *Newsletter's* last issue featured a list of CANUSA-related topics presented at the December 1982 joint meeting of the Entomological Societies of Canada and the United States. Here are abstracts from 13 talks given during the symposium on habitat manipulation and outbreak characteristics of the spruce budworm. Harold Batzer, Yvan Hardy, and Bart Blum moderated the discussion.

W. Lloyd Sippell: A Newly Recognized Characteristic of Eruptions of the Spruce Budworm in Ontario

Origins of spruce budworm outbreaks are identifiable only in retrospect. Historical larval sampling data (from Forest Insect Disease Survey) and observations associated with three recent outbreak origins in Ontario, the first since 1943, suggest the hypothesis that epicenters consist of small, heavy infestations which are relics from a previous outbreak. The hypothesis, if proven valid, offers high long-term hope of international outbreak containment at minimum environmental risk in North America through improved detection and monitoring/abatement programs following natural outbreak collapse.

J.L. Stanis and W.E. Miller: Effect of Minor Temperature Shifts and Density on Quality Factors of the Eastern Spruce Budworm

Studies of the eastern spruce budworm focusing on outbreak inception as related to weather and climate have been illuminating. However, they have not considered direct effects of temperature and other weather variables on budworm quality factors. This study attempts to fill this void by testing the effects of minor temperature shifts and density on the quality factors of lipid content and fecundity.

Groups of field-collected larvae were reared at three temperature regimes and two densities. Cooler temperatures were found to increase lipid content and fecundity, as did rearing the larvae at higher densities.

W.A. Smirnoff: The Possible Causes for the Permanence of Spruce Budworm Outbreaks

For many years, a detailed metabolic exploration was made of forest insect pests either healthy or supporting various infections. This led to the establishment of a biochemical index to diagnose or predict whether a forest insect pest population is expanding or decreasing, whether it should be treated, what type of treatment would be required, its potential efficacy, and its impact on the physiological state of populations surviving treatments.

The biochemical analysis conducted on *Choristoneura fumiferana* populations showed that larvae surviving treatments with chemical insecticides (organophosphates and carbamates) had a higher energy potential and vitality level than insects from untreated populations. Also, survivors from *Bacillus thuringiensis*-treated areas have a lower vitality level than insects from the two populations mentioned above. Results were as follows:

1. *Pupae from untreated populations*: Average weight: 69.5 mg; Ca+ +: 80 mg/kg; total proteins: 27.6 g/kg; α Hydroxybutyric dehydrogenase (α HBDH): 1004 ng; phosphatase: 541 ng
2. *Pupae from chemical insecticide-treated populations:* Average weight: 82.0 mg; Ca+ +: 114.5 mg/kg; total proteins: 36.3 g/kg; α HBDH: 1091.0 ng; phosphatase: 580 ng
3. *Pupae from* Bacillus thuringiensis*-treated territory:* Average weight: 46.9 mg; Ca+ +: 54.0 mg/kg; total proteins: 19.2 g/kg; α HBDH: 200 ng; phosphatase: 251.0 ng

These results showed that treatments with B.t. had a residual effect lowering the viability and fecundity of insects surviving treatment, while chemical insecticides favored appearance of spruce budworm populations with an increased energy potential and vitality level as a result of stimulation by sublethal doses of chemical insecticides, a phenomenon known as hormoligosis. Also, these results must be considered when it is time to establish strategies for the control of *C. fumiferana*, in order to evaluate the efficacy of B.t. treatments *v.* chemical insecticides. Finally, the reproducibility of the results obtained, over many years, suggested that hormoligosis, as a result of absorption of nonlethal dosages of chemical insecticides by larvae, is one of the major causes for the permanent outbreaks of *C. fumiferana*.

W.J. Mattson: Spruce Budworm Performance in Relationship to Foliar Macro-Micronutrients

Survival of spruce budworm larvae was positively correlated with the foliar levels of total nitrogen and potassium. Both male and female weight gains were also positively correlated with these same variables. Fertilizing trees with urea elicited increased growth of larvae — thereby experimentally confirming the importance of levels of foliar N on insect performance.

Scott S. Slocum and W.J. Mattson; Volatile Terpenes in Diets of the Spruce Budworm

Adult female dry weights of insects reared in cages on balsam fir and white spruce trees in 1981 were negatively correlated with foliar concentrations of alpha- and beta-pinene, camphene, and bornyl acetate on balsam fir ($N=34$, $R=0.17$, 0.14, 0.24, 0.20), and with bornyl acetate on white spruce ($N=10$, $R=0.78$). The experiment was repeated in 1982, but the analyses are not yet complete.

The degradation (or detoxification) of volatile terpenes by the spruce budworm digestive system was studied in 1981 and 1982 by comparing the concentrations of each compound in foliage and frass. Geranyl acetate was variably degraded (or detoxified) from balsam fir, black spruce, and white spruce foliage in a pattern that indicated that it might be a toxin in high concentrations or after a change of diet. Geranyl acetate will be subjected to lab feeding studies to test its possible toxicity.

C.N. Koller: Response of Spruce Budworm to the Condensed Tannins of Balsam Fir

Instar VI spruce budworm larvae were reared on a wheat germ casein diet to which 3 percent or 12 percent tannin was added. The tannins used were commercially available quebracho and that extracted from balsam fir foliage. The larvae consumed significantly more quebracho tannin diet and less of the balsam fir diet than did the controls. There was no significant difference within the tannin types due to tannin concentrations. The amount of larval growth was consistent with the consumption values.

Analysis of food and frass indicates that quebracho tannin is unchanged from food and frass. Balsam fir tannin is present in lower concentrations in frass than in food, indicating that it is altered in some fashion as it passes through the insect.

Although the concentration of tannin appears to be of little defensive importance within the range expected in plants, the quality of the tannin produced highly significant differences. This is contrary to expectations because tannins are widely viewed as nonspecific feed-

ing deterrents of a quantitative nature. The structure of the tannins is sufficiently variable to provide ample opportunities for qualitative differences in the foliage over the course of spruce budworm feeding.

J. Yvan Hardy: Effect of Three Host Species on the Performance of Spruce Budworm Larvae

Studies on the relative performance of spruce budworm on balsam fir, white spruce, and red spruce tend to demonstrate that the boreal environment provides a better source of food than the meridional environment. Environmental factors, and more particularly plant phenology and other tree characteristics (e.g., quantity of foliage production) tend to obscure this pattern in the field.

Under field conditions, fir appears to be a more suitable host in a boreal environment, where a better larval survival is observed. White spruce seems to be more suitable for budworm in a meridional environment because more foliage is produced, larval development is faster, and pupal weight is higher. Red spruce promotes the best survival of all three species, although overall larval development is slightly longer.

All three species are advantageous to the budworm depending on their respective location and should be recognized as such in any forest management program aimed at the prevention and control of spruce budworm outbreaks.

H.S. Crawford: Habitat Management for Birds that Prey on Spruce Budworm

In a study conducted in central Maine and eastern New Hampshire, birds consumed 2, 23, and 87 percent of an epidemic, transitional, and endemic budworm population, respectively. There were 128 breeding pairs of birds/40 ha in balsam fir stands under endemic spruce budworm populations. Bird populations in spruce-fir, mixed wood, and spruce stands exceeded those of fir stands by 1.5, 1.8, and 2.0 times, respectively. Decreasing the percentage of fir and increasing that of other species improves the habitat for birds that prey on the budworm. Mature stands support a greater population of birds that prey on budworm than do seral stands in the spruce-fir type.

Populations of birds that prey on spruce budworm can be improved by forest practices that increase (1) the degree of hardwood admixture with softwoods, (2) the proportion of spruce to fir, and (3) the diversity in horizontal and vertical stand structure.

A.G. Raske: Effect of a Spruce Budworm Outbreak on the Vulnerability Rating of a Fir-Spruce Forest

A vulnerability index to spruce budworm was applied to forest inventory data of the Province of Newfoundland before and after a budworm outbreak. The vulnerability index remained high to very high in most forest management units, although the outbreak was severe and did considerable damage.

R.A. Fleming, C.A. Shoemaker, and J.R. Stedinger: A Statistical Assessment of the Impact of Large-Scale Spraying Operations on the Regional Dynamics of Spruce Budworm (Lepidoptera:Tortricidae) Populations

Statistical techniques are employed to investigate the regional dynamics of managed budworm populations based upon survey data reporting spruce budworm egg density and balsam fir damage. The Maine Forest Service collected these data annually from 1975 to 1980 at approximately 1,000 locations throughout Maine's Spruce-Fir Protection District. Although spraying was often associated with "better"conditions in heavily damaged or infested areas, it was generally associated with somewhat "poorer" conditions in areas that had experienced only light defoliation or infestation in the previous year. The analysis also indicated that insecticide application may reduce budworm larval populations immediately after application, but the largest relative decrease in defoliation rates appeared the year after insecticide application. Furthermore, insecticide treatment was generally associated with some reduction in the variability of block egg densities, although the effectiveness of spraying varied considerably from year to year. Surprisingly, spraying was not associated with any substantial decline in block hazard rating. Insecticide treatments did not appear as effective as might be expected: in the year following application, the maximum reduction observed in average defoliation was 20 percent and in average egg-mass density was 50 percent.

Harold O. Batzer and Michael P. Popp: Forest Succession Following a Spruce Budworm Outbreak in Minnesota

Composition of the overstory changed from an average of 79 percent of the basal area in host species to 38 percent. The understory was adequately stocked with balsam fir in two-thirds of the stands. Only 4 percent of the regeneration was spruce. Raspberry, hazel, and mountain maple were the principal shrub species limiting balsam fir reproduction. Stands having a moderate mixture of nonhost species before the budworm outbreak had the most balsam fir regeneration because surviving balsam fir trees produced seed after the outbreak.

Robert M. Frank; Have 25 Years of Selection Management Reduced Initial Spruce Budworm Losses?

An 8.6-ha (21.2-acre) stand subjected to intensive selection management for 25 years was used to demonstrate that uneven-aged management is a viable option for reducing spruce budworm losses. Budworm feeding was initially observed in 1976 and was rated as moderate in 1981.

Stand treatments began in 1957 and are part of the compartment management studies being conducted on the Penobscot Experimental Forest near Bangor, Maine.

Three combined harvest, thinning, and timber-stand-improvement operations at 10-year intervals were conducted. Average stand volume was 109 m^3 ha (1550 ft^3 acre). The volume of balsam fir as a percentage of the total volume was reduced from 35 percent to 10 percent. Spruces, the favored species group, increased in representation from 25 percent to 57 percent. Other species remained relatively unchanged.

Results in terms of losses caused by budworm impact including growth loss and mortality loss were assumed to be proportional to the amount of balsam fir currently in the selection stand. Based on these assumptions, estimates of annual budworm impact losses ranged from a low of 1.1 m^3/ha (15.4 ft^3/acre) in the selection stand to as high as 4.7 m^3/ha (67.5 ft^3/acre) if the stand contained 35 percent fir and 6.8 m^3/ha (96.5 ft^3/acre) if the stand was 50 percent fir.

Barton M. Blum: Preliminary Results in the Phenology of Bud Flushing Among White Spruce Provenances

Variation among 24 provenances of white spruce planted on the Penobscot Experimental Forest in Bradley, Maine, was studied in the spring of 1981 and 1982. The planting was part of a range-wide test of growth characteristics established by the Institute of Forest Genetics, USDA Forest Service, in Rhinelander, Wisconsin, in 1962. Trees, planted as 2-2 stock, were 24 years old in 1982. Additional data were also collected in the spring of 1982 on 417 select white spruce trees comprising 30 families from Maine, New Hampshire, and Vermont outplanted on the Penobscot Experimental Forest in 1972. These trees were 12 years old from seed in 1982. For comparative purposes, a sample of 20 red spruce surrounding the provenance planting, and approximately the same age, were observed for phenology of bud flushing.

Degree-day accumulation over a threshold of 42°F was the independent variable of primary interest and was recorded for each tree when the first bud was observed to break dormancy and again when it was estimated that 95 percent or more of the buds had broken dormancy or flushed. A bud was assumed to have broken dormancy when the bud cap had broken enough that the field crews could see green needles.

The data have not been analyzed in depth as it is expected that another set of observations will be taken in 1983. However, preliminary plots of the data show that, for the provenance outplanting:

(1) Relative ranking of trees is very similar between the 1981-1982 seasons.

(2) In both seasons, two provenances (British Columbia, Montana) flushed considerably later than other provenances (based on provenance means). These outliers flushed about 420 cumulative degree days in 1981; about 330 in 1982. There was a gap of about 80 cumulative degree days between these provenances and the next latest provenance in 1981 and 55 days in 1982. The average red spruce broke bud at 560 cumulative degree days in 1981 and at 554 days in 1982. The outlying provenances broke dormancy about 3 calendar days earlier than red spruce in 1981 and 4 days earlier in 1982.

(3) There was a 23-day calendar spread among individual trees from the earliest tree to the latest tree to break bud (including outliers) in 1981 and a 22-day spread in 1982. Without the outliers this spread was 7 days in 1981 and 6 in 1982.

(4) The select tree outplanting showed some promising possibilities for improving bud break phenology if these data hold up in 1983:

Select-Tree Planting 1982 Growing Season

Date	Cumulative degree days	Percent of total pop.	Number of trees/cell
May 4	159	0.2	1
May 6	181	2.9	11
May 8	215	23.7	87
May 11	255	73.1	206
May 13	272	91.1	75
May 15	296	95.2	17
May 18	330	97.6	10
May 20	366	98.8	5
May 24	415	99.3	2
May 24	478	100.0	3
Red Spruce			
May 29	554 (20-tree average)		

Thus a total of five trees flushed only 4 days before red spruce, and three trees only 2 days before red spruce. It is planned to evaluate these trees for their growth characteristics also in 1983.

CANUSA Program Critique Underway

We reported in the November *Newsletter* (No. 25) that the Joint Policy and Program Council (JPPC) decided at its August 1982 meeting that the long-debated critique of the CANUSA Program should be completed without further delay. Only the effectiveness of Program organization and administration will be evaluated at this time; how well the Program met its objectives and provided useful products to meet users' needs will be looked at later, at the end of the extended Program.

F.L.C. Reed, Assistant Deputy Minister, Canadian Forestry Service, and R. Max Peterson, Chief, USDA Forest Service, have appointed a joint team from the two agencies to conduct the critique. The team includes

Kenneth L. Runyon, Maritimes Forest Research Centre, Fredericton, New Brunswick

Dennis Lachance, Laurentian Forest Research Centre, Ste. Foy, Quebec

Jack E. Coster, West Virginia University, Morgantown, West Virginia

Kenneth M. Knauer (Team Leader), USDA Forest Service, Washington, D.C.

Team members will conduct the critique according to a plan of work approved by the Joint Planning Unit (JPU). The team will contact people with a direct interest or involvement in the Program, including the national and regional administrative elements of the CANUSA Program in the United States and Canada and the JPU and JPPC. The critique report is scheduled for delivery to the JPU by March 31, 1983. Findings will be summarized briefly in the July *Newsletter*.

Spruce Budworm Damage Assessment/Hazard Rating Workshops

During 1982, CANUSA cooperators Chuck Olson and John Witter, both University of Michigan professors, organized and conducted two highly successful workshops in the Upper Peninsula of Michigan for the purpose of training foresters and pest management personnel to estimate budworm-caused damage done to host trees. By popular demand, Olson and Witter have agreed to team up with local remote-sensing specialists and offer the same workshops in New England this spring. Workshops will take place at the University of Maine, March 24-25; and at the University of Vermont, March 28-29. For further information call Olson or Witter at (313) 764-1413 or (313) 764-2249 or Marshall Ashley (UMO) at (207) 581-7312, or Ray Whitmore (University of Vermont) at (802) 656-2620.

Host-Forest Defoliator Interaction Workshop

The CANUSA Program, in conjunction with the Northeastern Forest Experiment Station's new Center for Biological control at Hamden, Connecticut, is planning to sponsor a Forest Defoliator-Host Interaction Workshop in early April. The meeting will focus on spruce budworms and gypsy moth host relationships. The purpose is to promote understanding of these relationships and foster communication among researchers in this field. For further information, contact Bob Talerico at (215) 461-3017.

More on the August Utilization Technology Meeting

Tom Corcoran, of the College of Forest Resources at the University of Maine, Orono (UMO), has given the *Newsletter* more details about the 3-day conference we mentioned in the January issue. The meeting is entitled "From Stump to Mill — Advances in Spruce-Fir Utilization Technology" and will take place August 17-19 at Orono. The technologies associated with harvesting, energy, pulp and paper, and wood products in regard to the spruce-fir resources of the northeastern United States and eastern Canada will be addressed by four groups of distinguished North American industrialists, scientists, and government officials. The conference will particularly concentrate on the technological opportunities and problems arising from the utilization of live and dead spruce and fir.

Four committees headed by university personnel have been formulated to develop the conference program. Ben Hoffman, of UMO's Division of Forestry, will coordinate the harvesting committee. Norm Smith, of the Agricultural Engineering Department, heads the energy group. Joe Genco, of the Chemical Engineering Department, leads the pulp and paper organizers, and Jim Shottafer, of the Wood Products Laboratory, guides the lumber and solid wood committee. Overall planning is the responsibility of Stan Marshall, from the UMO Pulp and Paper Foundation, and Tom Corcoran. The USDA Forest Service and Maine's Forestry Division join the university as cosponsors of the conference.

For more information on the program, contact Tom at (207) 581-2846.

CANUSA Investigators: Plan Ahead for the SAF

The 1983 national meeting of the Society of American Foresters (SAF) will be held in Portland, Oregon, October 16 to 19. In addition to invited papers, technical sessions, and field trips by working groups, there will be time and space allocated for poster displays, which is a first for the Society. A number of organizations have found poster sessions to be a very effective way to disseminate research results and ideas to a group. Please keep this in mind as a potential outlet for your CANUSA work. (The 1984 CANUSA international symposium will also have a poster session, so please consider "field testing" your poster on the SAF crowd before bringing it to our Bangor meeting.)

Additional information will be available in a future issue of the *Journal of Forestry*, or contact Ed Robie at SAF headquarters, (301) 897-8720.

Bibliography Supplement News

The *Spruce Budworms Bibliography — Supplement 2*, published last fall, has been entered into the National Technical Information Service files. The NTIS accession number is PB 83-134650; paperbound copies are $11.50 and microfiche, $4.50. Order from this address:

NTIS
U.S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161

Supplement 3 is in the final stages of preparation, and should go to press by early summer.

CANUSA-East Publications in Progress

Listed below are the tentative titles and senior authors for 18 handbooks/guides currently being written by CANUSA cooperators. Manuscripts for 7 of these are already well along in the necessary review-revision-editing process.

Senior Author	Title	Expected Publication
Adamus	Techniques for monitoring the environmental impacts of insecticides on aquatic ecosystems	1983
Allen	Monitoring spruce budworm population trends with pheromone traps	1984
Bradley	Estimating harvesting costs of spruce-budworm-damaged stands of balsam fir and white spruce	1983
Dimond	A practical guide to reducing the use of insecticides against spruce budworm by targeted harvesting and spraying	1983
Grimble	Regional evaluation of B.t. for spruce budworm control in Maine and Canada	1983
Hardy	An atlas of spruce budworm epidemiology in eastern North America	1983
Jennings	Techniques for measuring early-larval dispersal of spruce and jack pine budworms	1983
Jennings	An automated egg-mass counter for spruce budworm surveys	1984
Jennings	Field manual for identification of common predators of spruce budworms	1984
Marty	A guide to economic evaluation of spruce budworm management opportunities	1983
Montgomery	Insecticides for control of spruce budworms	1983
Morris	Guide for operational use of B.t. for spruce budworm suppression in Canada and the United States	1983
Olson	Application of hazard rating to continuous forest inventory	1983
Schmitt	A user's guide for managing spruce budworms in eastern North America	1983
Shigo	Applications for the Shigometer on spruce budworm hazard rating	1983
Sinclair	Guide for utilization and marketing of salvaged balsam fir trees killed by the spruce budworm	1983
Tilles	Field manual for identifying common parasites of the spruce budworm	1983
Witter	Guide to hazard rating spruce-fir stands in the Lake States and Maine	1984

Personnel

CANUSA—West Information Coordinator Martha Brookes has been asked to chair a new committee of the Council of Biology Editors. The committee will be responsible for planning and conducting workshops to provide training at annual meetings of the organization. Two subjects under consideration for such workshops are computer literacy for editors and indoctrination for new editors of biological journals.

D. Gordon Mott, long-time CANUSA investigator with the USDA Forest Service at Orono, Maine, retired in late 1982. Gordy had been a fixture at northeastern silviculture- and budworm-related meetings for two decades. Rumor has it that he reports to the office about as much now as ever! We expect to continue the Program's relationship with Gordon for a while longer, as he is coauthor with John Dimond on a USDA handbook on reducing the use of insecticides against budworm through targeted harvesting and spraying. After that brochure is complete, CANUSA will send Gordon back to his real love — coyotes. He has reared several coyote pups and made an extensive study of their vocal communication, both within the Mott pack and among his coyotes and wild packs living near his homestead.

Wendell Roelofs, entomologist at Cornell and former CANUSA investigator, has received the $100,000 Wolf Prize for research in agriculture entomology. Roelofs' work for CANUSA centered on the use of pheromones to control spruce budworm populations.

Out and About

CANUSA's latest publication, O.H. Lindquist's *Keys to Lepidopterous Larvae Associated with the Spruce Budworm in Northeastern North America*, was released in December 1982. Publication financing was furnished by the American side, and the brochure was printed in Canada through the Canadian Forestry Service. Free copies are available from the Environment Canada Distribution Center, 151 Jean-Proulx Street, Hull, Quebec K1A 1C7. The handbook is also printed in French, under the title *Clés d'Identification des Larves de Lépidoptères Apparentées à la Tordeuse des Bourgeons de l'Épinette dans le Nord-Est de l'Amérique du Nord.*

Items from the Press

Spruce budworm threatens. — An annual aerial survey of forest insect conditions shows a serious increase in infestation of the western spruce budworm in eastern Oregon. The outbreak has grown to more than 1.5 million acres. It was detected in 1980 on 2300 acres, and grew to 312,000 acres in 1981.

A team of specialists from the Oregon Department of Forestry, the Bureau of Land Management, and the Forest Service has begun an environmental analysis of the outbreak to see what action, if any, may be necessary to control the infestation.

Most of the infestation is on private lands and the Wallowa-Whitman, Umatilla, Malheur, and Ochoco NF's with lesser amounts on State and BLM lands.

Last June and July, 178,549 acres of infestation in the Blue Mountains of eastern Oregon were sprayed with Sevin-4 Oil and Orthene. Forest officials say this area will not need retreatment.

(Greensheet — November 26, 1982)
USDA Forest Service, Region 6
Portland, Oregon

Federal and state agencies say chemical and biological controls may be used on as many as 1.4 million acres in eastern Oregon late this spring to control an outbreak of western spruce budworm.

The U.S. Forest Service, U.S. Bureau of Land Management and State Department of Forestry said the amount of spraying will depend on allocation of federal and state funds and insect sampling in May and early June to be sure treatment is imperative.

The agencies said most of the acreage would be sprayed with Sevin-4-oil and Orthene, but a biological control may be used in some "sensitive areas." In order to protect current budworm research being conducted on the Starkey Experimental Station, there will be no treatment in that area west of La Grande.

Acreage affected by the insect consists of mixed-ownership lands on or adjacent to the Malheur, Ochoco, Umatilla and Wallowa-Whitman national forests. Almost 180,000 acres treated last year will not be treated again this year.

If sufficient money is not available to spray the entire acreage, priorities for treatment will be established based on cost benefits, ownership patterns, larva populations and other factors.

(United Press International — January 11, 1983)
Portland, Oregon

Budworms Get Antsy. — Ants may play a more important role as predators of the western spruce budworm than has been expected, say two researchers from the Forest Service's Pacific Northwest Station.

Robert W. Campbell and Torolf R. Torgersen conducted tests in the Okanogan National Forest in Washington — they wired twigs containing budworm pupae to branches where a sticky barrier had been applied to prevent access to walking invertebrate predators. Pupae were also attached to untreated branches. The two groups were then compared. Results at one site indicated that the untreated branches had 85 percent of the pupae removed or reduced to fragments within three days. In contrast, only about eight percent of the pupae were removed where a sticky barrier had been applied around the branch base.

Since the sticky barriers would not deter either flying predators or small mammals, the early results indicate that small walking insects were the cause of pupae destruction. Evidence of ants in the vicinity was common.

Similar results were obtained in a second trial, and researchers are hopeful that future trials will cast more light on the role of ants in the population dynamics of the western spruce budworm.

(American Forests — January 1983)

Forestry Hurt. — The greatest constraints faced by forestry operations in recent years have arisen because of public opposition to the use of pesticides that are fully registered for use in forestry, said John Smith, senior director of program planning for the Nova Scotia Department of Lands and Forests.

In an address to the Farm Women's Conference in Truro, Mr. Smith said forestry operations are not unduly constrained by statutory environmental requirements. "There is something very paradoxical in all of this. The insecticides and herbicides registered for use in forestry were originally developed for use in agriculture."

Mr. Smith said these insecticides and herbicides are far fewer in number than those available in agriculture. "Registration for forestry use is seemingly much more difficult to obtain, and even when obtained, public opposition to forestry use is much greater than in agriculture. This, despite the fact forestry operations are more remote from the resident populations and the use in forestry is only a fraction of that in agriculture."

(Chronicle-Herald — November 4, 1982)
Halifax, Nova Scotia

Budworms may help forest growth, researchers claim. — Researchers have found that forest management may have helped promote populations of tree-eating insects while the bugs themselves may have enhanced the growth of forests.

This apparent paradox is among the findings of a group headed by Tom Hinckley, professor of forest resources at the University of Washington.

Hinckley, fellow forestry professor David Scott and six graduate students are preparing a study for the U.S. Forest Service on the effects of the spruce budworm on forests of Douglas fir and grand fir.

He said some logging practices, such as cutting ponderosa pines that have a high resistance to budworm attack and replacing them with firs, can increase the budworms' food supply and help the insects multiply.

While the insects may retard tree growth, they also can act as a fertilizer, Hinckley said. "Defoliation by insects may actually be a source of nutrients for tree growth, rather than merely a cause of tree death," he said.

While observing the effects of budworms in the Blue Mountains of eastern Oregon, Hinckley noticed his tent was covered with excrement from the insects every evening.

He noted scientists at Oregon State University have found sick trees are more likely to be attacked by pests. The insects therefore may help weed out unhealthy trees that compete for nutrients with the healthy specimens.

"It's very difficult to assess this," said Hinckley. "Man has been harvesting the biggest and the best trees in the forest. We don't know if the presence of the dominant trees would help control infestations by itself."

He said trees can lose up to 50 per cent of their new spring foliage without suffering measurable loss of growth in a given year. Some forests in Oregon have suffered nearly 80 per cent loss of new foliage in a single year without appreciable loss of tree growth.

"Forests have a great ability to compensate for one-time damage," Hinckley said. "The effects of the eruption of Mount St. Helens, for instance, were not as severe as we might have guessed.

"Trees that lost a lot of foliage in the eruption grew 50 to 70 percent less than normal in 1980 (following the May 18 explosion). But in 1981, they put out more foliage than normal."

(The Citizen — December 10, 1982)
Ottawa, Ontario

Recent Publications

From the School of Natural Resources, University of Michigan, Ann Arbor, MI 48409, you may request

Olson, C.E., Jr., P.J. Sacks, J.A. Witter, and L.A. Bergelin. 1982. "Spruce budworm damage assessment with 35 mm air photos: a training manual." Rep. 82-1A. Ann Arbor: University of Michigan, School of Natural Resources, Remote Sensing Lab. 43 p., illustrated.

The January issue listed Chet Himel's speech on droplet physics given at the June 1982 meeting of the American Society of Agricultural Engineers. We just found out that Alam Sundaram also presented a talk there. Her subject was foliar impaction and distribution of aerially sprayed encapsulated droplets. To order the proceedings, recheck this space in the January *Newsletter* (number 26).

The same Society, meeting with the National Agricultural Aviation Association in December of 1982, hosted W.E. Yates, R.E. Cowder, and N.B. Akesson. Their topic, the effect of air speed, nozzle orientation, and spray concentration in drop size spectrums (paper no. AA-82-003), is also available from the St. Joseph, Michigan, address in the January issue.

A note in the January issue of *American Forests* mentions a publication that will interest *Newsletter* readers on the U.S. side. *How to Take Reforestation Tax Deductions and Tax Credits* describes special tax deductions for tree-planting expenses for timber retroactive to January 1980. Applicable expenses include direct costs of site preparation, brush removal to protect seedlings for 2 years, herbicides, seeds and seedlings, all planting costs, fuel, supervision, and other expenses. These deductions and credits can be claimed even by U.S. taxpayers who take only the standard deduction. With the new tax law, tree growers in the 50-percent tax bracket can recover over half their investment as tax rebates over 7 years.

The book includes worksheets, tax forms, tax tables, and a comprehensive example. To order, write to Leray Press, Box 130C, 103 Goodwin Ave., Midland Park, NJ 07432. The price is $11.95 ($12.55 to New Jersey residents).

To get more information or to have your name added to the mailing list for the *Newsletter*, contact

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